CLAIMS:

1. A problem solution acquisition method whereby a problem is sent from a requesting system, which requests a solution of an input problem, to a solving system, and a solution of the problem is found in said solving system, sent to said requesting system and output from said requesting system, said problem solution acquisition method comprising the steps of:

enciphering, in said requesting system, an input problem by using a ciphering key;

sending said enciphered problem to said solving system;

solving, in said solving system, said sent enciphered problem while keeping said sent enciphered problem in an enciphered state, and finding a solution;

sending said found solution to said requesting system; and

deciphering, in said requesting system, said sent solution by using said ciphering key and outputting said deciphered solution from said requesting system.

2. An optimization problem solution acquisition method whereby an optimization problem is sent from a requesting system, which requests a solution of an input optimization problem, to a solving system, and a solution of the optimization problem is found in said solving system, sent to said requesting system and output from said requesting system, said optimization

problem solution acquisition method comprising the steps of:

converting, in said requesting system, said optimization problem into another optimization problem having a different equality $g'(y) = 0$, a different inequality constraint $h'(y) \geqq 0$, and a different objective function $f'(y)$ by using a suitably determined variable conversion $y = u(x)$ and equivalent transformation of expressions;

sending said converted optimization problem to said solving system;

solving, in said solving system, said sent converted optimization problem, and finding a solution y;

sending said found solution y to said requesting system; and

conducting, in said requesting system, reverse conversion of the variable $x = u^{-1}(y)$ on said sent solution y, finding a solution x of the original optimization problem, and outputting said solution x from said requesting system.

3. An optimization problem solution acquisition method according to claim 2, wherein,

if the equality constraint of said optimization problem is represented as $Ax = b$, where A is a coefficient matrix having m rows and n columns, and b is an m-dimensional right hand side vector, then

as said variable conversion, linear

transformation $y = Q^{-1}x$ using a permutation matrix Q having n rows and n columns is used,

as said equivalent transformation of expressions, processing of multiplying both hand sides of said equality constraint Ax = b by a nonsingular matrix P having m rows and m columns is used, and

as said reverse conversion of the variable, linear transformation x = Qy is used.

4. An optimization problem solution acquisition method according to claim 3, wherein

a matrix P_2P_1 is used as said nonsingular matrix P, and

a matrix Q_1Q_2 is used as said permutation matrix,

where

P_1 is a left permutation matrix having m rows and m columns for transforming said coefficient matrix A into a bordered block diagonal form, and

Q_1 is a right permutation matrix having n rows and n columns for transforming said coefficient matrix A into the bordered block diagonal form, and

in a block diagonal form P_1AQ_1 obtained by making said P_1 and Q_1 act on said coefficient matrix A,

P_2 is a matrix for conducting linear transformation only between rows in each diagonal block, and

Q_2 is a matrix for conducting permutation only between columns in each diagonal block.

5. A solving system of an optimization problem

including one or more client computer systems for accepting a solving request of an optimization problem from a user, a server computer system for finding a solution of the given optimization problem, and a network for connecting said client computer systems to said server computer system,

wherein said client computer system comprises:

a problem input interface for accepting an input of an optimization problem represented by an equality constraint $Ax = b$ defined by a coefficient matrix A having m rows and n columns and an m-dimensional right hand side vector b, an inequality constraint $x \geqq 0$, and an objective function $f(x)$ to be minimized;

a ciphering key input interface for accepting a ciphering key;

a conversion matrix generation routine for generating a nonsingular matrix P having m rows and m columns and a permutation matrix Q having n rows and n columns by using said ciphering key input from said ciphering key input interface;

a problem conversion routine for converting said optimization problem into another optimization problem having a different equality constraint $(PAQ)y = Pb$, a different inequality constraint $y \geqq 0$, and a different objective function $f(Qy)$, by using said nonsingular matrix P and said permutation matrix Q;

a problem output interface for sending the converted optimization problem to said server computer system via said network; and

a reverse conversion routine for conducting reverse conversion $x = Qy$ on a solution y of the converted optimization problem received from said server computer system and thereby finding a solution x of the original problem.

6. A solving service processing method in a system including one or more client systems and a server system for finding a solution of an optimization problem, said solving service processing method comprising the steps of:

sending a program from said server system to said client system in response to a service start request issued by said client system, said program making a computer implement:

(1) a problem input function of accepting a user's input of an optimization problem represented by an equality constraint $Ax = b$ defined by a coefficient matrix A having m rows and n columns and an m-dimensional right hand side vector b, an inequality constraint $x \geqq 0$, and an objective function $f(x)$ to be minimized;

(2) a ciphering key input function of accepting a ciphering key from from the user;

(3) a conversion matrix generation function of generating a nonsingular matrix P having m rows and

m columns and a permutation matrix Q having n rows and n columns by using said ciphering key input by said ciphering key input function;

(4) a problem conversion function of converting said optimization problem into another optimization problem having a different equality constraint (PAQ)y = Pb, a different inequality constraint $y \geqq 0$, and a different objective function f(Qy), by using said nonsingular matrix P and said permutation matrix Q;

(5) a problem output function of outputting the converted optimization problem to send it to an external system;

(6) a solution input function of receiving a solution y of the converted problem from the external system;

(7) a reverse conversion function of conducting reverse conversion x = Qy on the solution y by using the matrix Q generated by the function of (3) and thereby finding a solution x of the original problem; and

(8) a solution output function of outputting the reverse-converted solution x;

receiving, in said client system, said program;

implementing, in said client system, said functions of (1), (2), (3), (4) and (5) of said received program, thereby converting an optimization problem into a different problem, and sending said

different problem to said server system;

finding, in said server system, a solution y of said received different problem;

sending said solution y from said server system to said client system; and

implementing, in said client system, said functions of (6), (7) and (8) of said program, and thereby obtaining a solution x of the original optimization problem.

7. A solving service processing method in a system including one or more client systems, a server system for finding a solution of an optimization problem, and a program providing system, said solving service processing method comprising the steps of:

notifying, from said server system, said client system of said client system in response to a service start request issued by said client system;

requesting, from said client system, said program providing system to send a program;

sending, from said program providing system, a program to said client system, said program making a computer implement:

(1) a problem input function of accepting a user's input of an optimization problem represented by an equality constraint $Ax = b$ defined by a coefficient matrix A having m rows and n columns and an m-dimensional right hand side vector b, an inequality constraint $x \geqq 0$, and an objective function f(x) to be

minimized;

(2) a ciphering key input function of accepting a ciphering key from from the user;

(3) a conversion matrix generation function of generating a nonsingular matrix P having m rows and m columns and a permutation matrix Q having n rows and n columns by using said ciphering key input by said ciphering key input function;

(4) a problem conversion function of converting said optimization problem into another optimization problem having a different equality constraint $(PAQ)y = Pb$, a different inequality constraint $y \geqq 0$, and a different objective function $f(Qy)$, by using said nonsingular matrix P and said permutation matrix Q;

(5) a problem output function of outputting the converted optimization problem to send it to an external system;

(6) a solution input function of receiving a solution y of the converted problem from the external system;

(7) a reverse conversion function of conducting reverse conversion $x = Qy$ on the solution y by using the matrix Q generated by the function of (3) and thereby finding a solution x of the original problem; and

(8) a solution output function of outputting the reverse-converted solution x;

receiving, in said client system, said

program;

implementing, in said client system, said functions of (1), (2), (3), (4) and (5) of said received program, thereby converting an optimization problem into a different problem, and sending said different problem to said server system;

finding, in said server system, a solution y of said received different problem;

sending said solution y from said server system to said client system; and

implementing, in said client system, said functions of (6), (7) and (8) of said program, and thereby obtaining a solution x of the original optimization problem.

8. A program for making a computer implement:

a problem input function of accepting an input of an optimization problem represented by an equality constraint $Ax = b$ defined by a coefficient matrix A having m rows and n columns and an m-dimensional right hand side vector b, an inequality constraint $x \geqq 0$, and an objective function $f(x)$ to be minimized;

a ciphering key input function of accepting a ciphering key;

a conversion matrix generation function of generating a nonsingular matrix P having m rows and m columns and a permutation matrix Q having n rows and n columns by using said ciphering key input by said

ciphering key input function;

a problem conversion function of converting said optimization problem into another optimization problem having a different equality constraint $(PAQ)y = Pb$, a different inequality constraint $y \geqq 0$, and a different objective function $f(Qy)$, by using said nonsingular matrix P and said permutation matrix Q;

a problem output function of outputting the converted optimization problem;

a solution input function of receiving a solution y of the converted problem;

a reverse conversion function of conducting reverse conversion $x = Qy$ on the solution y by using the matrix Q generated by said conversion matrix generation function and thereby finding a solution x of the original problem; and

a solution output function of outputting the reverse-converted solution x.